

Evaluation of Water Temperature Regimes in the Snake River using Transect Measurements and the RBM10 Model

In order to evaluate impacts to the temperature of the mainstem Columbia and Snake rivers, EPA Region 10 has developed a dynamic, one-dimensional heat budget model (RBM10) of the basin. While EPA continues to apply RBM10 using long-term records (tributary inflows/temperatures, meteorology, etc.) to evaluate temperature variability over time, this report focuses on detailed monitoring information collected by the Columbia River Inter-Tribal Fish Commission (CRITFC) and Fisheries and Aquatic Sciences in the early 1990s at 18 locations in the Snake River (Karr et al, 1998). This transect data is used to examine heat transfer at dams and thermal stratification. The report also compares cross-sectionally averaged temperatures from the transect measurements to simulated temperatures from RBM10.

The following conclusions are drawn from this evaluation:

- (1) Small differences in cross-sectionally averaged temperatures above and below each of the dams indicate that the dams transfer heat downstream rather than store heat. This lends support to the use of one-dimensional temperature model for the lower Snake River and other large rivers with run-of-the-river dams.
- (2) Thermal stratification in the four Snake River reservoirs, measured as the mean difference between surface temperatures and cross-sectionally average temperatures, ranged from 0.97 °C at Lower Monumental Dam to 1.22 °C at Ice Harbor Dam over the summer 1991 transect record. They ranged from 0.96 °C at Lower Monumental Dam to 1.65 °C at Lower Granite Dam over the summer 1992 transect record.
- (3) Stratification occurs throughout the summer months in the four reservoirs, and flow augmentation appears to increase stratification.
- (4) The mean difference between simulated and measured temperatures over the summer 1992 period at four transect locations ranged from -0.25 °C to 0.20 °C.
- (5) The time of arrival of cold water from Dworshak releases tends to be longer in the simulations than in the measurements beginning at the Lower Granite forebay station. This may be caused by elevated velocities in a gravity-underflow of cold water from the mixed Snake and Clearwater rivers during flow augmentation, which is not simulated in the RBM10 model.
- (6) The timing and magnitude of cold water fronts suggests that errors associated with numerical dispersion and continuity-based hydrodynamics in RBM10 are minor.
- (7) Incorporation of longitudinal dispersion in RBM10 may improve accuracy in the timing and magnitude of cold water fronts.